UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/674,241	09/29/2003	Horace P. Yuen	6407	1887

22922 7590 08/17/2007
REINHART BOERNER VAN DEUREN S.C.
ATTN: LINDA KASULKE, DOCKET COORDINATOR
1000 NORTH WATER STREET
SUITE 2100
MILWAUKEE, WI 53202

EXAMINER	
ALMEIDA, DEVIN E	

ART UNIT	PAPER NUMBER
2132	

MAIL DATE	DELIVERY MODE
08/17/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

5

Office Action Summary	Application No.	Applicant(s)
	10/674,241	YUEN ET AL.
	Examiner	Art Unit
	Devin Almeida	2132

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 22 June 2007.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-50 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-9,11-17,19-25,27-30,33-40 and 42-50 is/are rejected.

7)☒ Claim(s) 10,18,26,31,32,41 is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

This action is in response to the papers filed 6-22/2007. Claims 1-50 were received for consideration. Amendments were made to claims 1, 6, 7, 11, 15, 17, 18, 22, 25, 26, 30, 31, 32, 33, 36, 40, 41 and 48.

Response to Arguments

Applicant's argument with respect to 35 USC 112 rejections has been fully considered and is persuasive.

Applicant's argument with respect to 35 USC 103 rejections has been fully considered and is not persuasive. In response to applicant's argument that there is no suggestion to combine the references, the examiner recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988)and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). In this case, it is well to one of ordinary skill in the art that the larger the encryption key the more secure the encryption is.

Applicant's argument with respect to 35 USC 103 rejections that the prior art system only sends one proton while this system sends at least 10 on average has been fully considered and is not persuasive. Townsend (U.S. Patent # 5,675,648) teaches that each pulse contains many photons (see column 5 lines 31-56 and column 8 line 58

– column 9 lines 44 i.e. The transmitter T includes both a quantum channel source 71 for use in establishing a key by quantum cryptography, and also a conventional intensity-modulated source for outputting multi-photon signals for the calibration phase and also for carrying conventional traffic).

Claim Rejections - 35 USC § 112

Claims 1, 7, 11, 15, 22, 30, 33 and 36 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claim 1 recites the limitation "running key" in line 10 of claim 1. There is insufficient antecedent basis for this limitation in the claim. For the application of art, "running key" is construed to be the same key as the "long extended key".

The term "of at least 10 photons on average" in claim 1, 6, 11, 15, 22, 30, 36 and 48 is a relative term which renders the claim indefinite. The term "of at least 10 photons on average" is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and

> the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1-9, 11-17, 19-23, 27- 29 and 48-50 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dultz et al. (U.S. Patent # 6,748,081) in view of (Schneier "Applied Cryptography Second Edition: protocols, algorithms, and source code in C") in further view of Townsend (U.S. Patent # 5,675,648). Dultz teaches with respect to claim 1, using the running keys derived from the extended keys to choose one of many possible quantum or classical signal sets embodied in a number of modes of electromagnetic or acoustic or other physical origins (see Dultz column 2 line 46 – column 4 line 10 i.e. two optical bases, 0 and 1); and adjusting the signal strength of each signal in the signal sets in accordance with the number of signal sets to obtain a desired security level, wherein quantum or classical noise in the system hides both encrypted data bits and the running key preventing a third eavesdropping party from success in compromising message transmissions between the first and second parties (see Dultz column 2 line 46 – column 4 line 10 i.e. polarization of light). Dultz does not teach teaches, a method for achieving data encryption and/or key expansion/generation, said method comprising the steps of: providing a short, shared, secret, seed key between first and second parties, the seed key allowing the first and second parties to encrypt and decrypt messages transmitted between the first and second; extending the seed key to a long extended key and to use of at least 10 photons on average. Schneier teaches, a method for achieving data encryption and/or key expansion/generation, said method comprising the steps of: providing a short, shared, secret, seed key between first and second parties, the seed key allowing the

first and second parties to encrypt and decrypt messages transmitted between the first and second parties (see Schneier figure 12.1 and page 270-278); extending the seed key to a long extended key (see Schneier figure 12.1 and page 270-278). It would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains to have used a DES encryption algorithm which a key is extended key to a longer key and then broken up into blocks which are used to encrypt the data being sent. By used a longer extended key the security of the encryption is increase. Therefore one would have been motivated to extending the seed key to a long extended key of any size larger then the seed key to increase the security. Townsend teaches the use of at least 10 photons on average (see column 5 lines 31-56). It would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains to have used a multi photon source to increase the flexibility of the system for carrying conventional traffic. Therefore one would have been motivated to have used at least 10 photons on average.

With respect to claim 2, the signal sets are based on a number of modes of energy carrying waves either in free space or in guided media (see Dultz column 3 lines 11-17 i.e. fiber link).

With respect to claim 3, the energy bearing waves are electromagnetic waves, including radio waves, microwaves, millimeter waves, or light waves (see Dultz column 3 lines 11-17 i.e. light wave).

With respect to claim 4, the modes are two modes of the light waves, and wherein the two modes of light waves are polarization modes, time or frequency modes,

spatial modes or any combination of such physical attributes of the light waves (see Dultz column 2 line 46 – column 4 line 10 i.e. polarization of light as a function of time, photon in the transmitter generates a pulse, and different wave length).

With respect to claim 5, implemented over all types of networks, including enterprise, metro, short haul, and long haul, and independent of underlying software protocols (see Dultz abstract).

With respect to claim 6, a method for encrypting data, said method comprising the steps of: generating a large number of quantum signal sets of low to high energy (see Dultz column 2 line 46 – column 4 line 10 i.e. high-energy photon of the laser breaks down into two low-energy-energy); and modulating the sets of quantum signal with the data being encrypted by using a multi-bit seed key suitably extended to obtain running keys to select quantum signal sets for different bit values (see above Schneier figure 12.1 and page 270-278 i.e. K_1, $K_2 \ldots K_n$), whereby each quantum signal set is encoded into a coherent state with at least 10 photons on average (see Dultz column 2 line 46 – column 4 line 10 i.e. high-energy photon) of an infinite-dimensional space or any other quantum state in space of any dimension (See Dultz figure 3b and column 2 line 46 – column 4 line 10).

With respect to claim 7, including the step of extending the multi-bit seed key K into a longer extended key K' and using the extended key K' to determine for each qumode carrying bit, b (0, l), which quantum signal set is to be used (see Dultz column 2 line 46 – column 4 line 10 i.e. two optical bases, 0 and 1).

With respect to claim 8, the extended key K' includes 2^s-1 bits, where s is the number of bits of the seed key K (see above Schneier page 270-278 i.e. increasing the encryption key by any amount will increase the security of the transaction), and wherein using the extended key K' to determine qumodes includes segmenting the extended key K' into disjointed blocks of r-bit running keys R, where $r = \log_2(M)$ and s >> r, wherein r is the number of bits of each of the running keys R, and M is the number of bases for the coherent states (see above Schneier figure 12.1 and page 270-278 i.e. K_1, $K_2 \ldots K_n$).

With respect to claim 9, each quantum signal set is composed of any number of photons from small to large, and including the step of coding all of the photons of a given quantum signal set to represent a bit value for that quantum signal set (see Dultz column 2 line 46 – column 4 line 10 i.e. high-energy photon of the laser breaks down into two low-energy-energy).

With respect to claim 11, a method for encrypting data, comprising the steps of: providing a multi-bit seed key; said method extending the multi-bit seed key K to produce a multi-bit extended key K', the length of the extended key being substantially greater than the length of the seed key K; segmenting the extended key K' into a plurality of disjointed running keys R (see above Schneier figure 12.1 and page 270-278 i.e. K_1, $K_2 \ldots K_n$); and modulating an energy bearing wave carrying quantum or classical noise with at least 10 photons on average (see Dultz column 2 line 46 – column 4 line 10 i.e. high-energy photon) using the running keys R to select different bit values for different portions of the energy bearing wave to thereby encrypt the energy bearing

wave with the data (see Dultz column 2 line 46 – column 4 line 10 i.e. polarization of light into two optical bases, 0 and 1).

With respect to claim 12, the energy bearing wave is an electromagnetic wave, including a radio wave, a microwave, millimeter waves, or a light wave (see Dultz column 3 lines 11-17 i.e. light wave).

With respect to claim 13, the extended key K' includes 2^s-1 bits, where s is the number of bits of the seed key K (see above Schneier figure 12.1 and page 270-278 i.e. K_1, $K_2 \ldots K_n$).

With respect to claim 14, the step of segmenting the extended key K' into blocks includes segmenting the extended key K into blocks of r-bit running keys R, where r is the number of bits of each of the running keys R, and s >> r (see Schneier figure 12.1 and page 270-278 i.e. K_1, $K_2 \ldots K_n$).

With respect to claim 15, a method for encrypting comprising the steps of: data, said method producing a light signal that includes a plurality of polarization-mode coherent states of light (see Dultz column 2 line 46 – column 4 line 10 i.e. polarization of light as a function of time) with at least 10 photons on average (see Dultz column 2 line 46 – column 4 line 10 i.e. high-energy photon); extending a multi-bit seed key K to produce a multi-bit extended key K' the length of which is substantially greater than the length of the seed key K (see Schneier page 270-278); segmenting the extended key K' into a plurality of disjointed blocks of running keys R, each being r bits in length (see Schneier figure 12.1 and page 270-278 i.e. K_1, $K_2 \ldots K_n$); and modulating a finite number of the polarization-mode states of light using the running keys R to produce a multi-bit

information bearing light signal (see Dultz column 2 line 46 – column 4 line 10 i.e. polarization of light into two optical bases, 0 and 1) with at least 10 photons on average (see Dultz column 2 line 46 – column 4 line 10 i.e. high-energy photon).

With respect to claim 16, the polarization-mode states comprise two-mode coherent states of light, and including the step of using the extended key K' to determine, for each qumode carrying bit, b (0,1), which pair of signals is to be used (see Dultz column 2 line 46 – column 4 line 10 i.e. two optical bases, 0 and 1).

With respect to claim 17, each quantum signal set includes at least 1,000 photons (see Dultz column 2 line 46 – column 4 line 10 i.e. high-energy photon), and including the step of coding all of the photons of a given quantum signal set to represent a bit value for that quantum signal set (see Dultz column 2 line 46 – column 4 line 10 i.e. polarization of light into two optical bases, 0 and 1).

With respect to claim 19, the extended key K' includes 2^s-l bits, where s is the number of bits of the seed key K (see above Schneier figure 12.1 and page 270-278 i.e. K_1, $K_2 \ldots K_n$).

With respect to claim 20, wherein signal components of the light signal are macroscopically distinguishable (see Dultz column 2 line 46 – column 4 line 10 i.e. two optical bases, 0 and 1).

With respect to claim 21, wherein the extended key K' is segmented into disjointed blocks of r-bit running keys R, where $r = \log_2(M)$ and s >> r, r is the number of bits of each of the running keys R, and M is the number of bases (see above Schneier figure 12.1 and page 270-278 i.e. K_1, $K_2 \ldots K_n$).

With respect to claim 22, a method for encrypting data, said method comprising the steps of: producing a light signal that includes two-mode coherent states of light (see Dultz column 2 line 46 – column 4 line 10 i.e. two optical bases, 0 and 1) with at least 10 photons on average (see Dultz column 2 line 46 – column 4 line 10 i.e. high-energy photon); extending a multi-bit seed key K to produce a multi-bit extended key K', the length of which is greater than the length of the seed key K (see Schneier page 270-278); segmenting the extended key K' into a plurality of disjointed blocks of running keys R, each of the running keys being r-bits in length (see above Schneier figure 12.1 and page 270-278 i.e. K_1, $K_2 \ldots K_n$); and modulating a finite number of the two-mode coherent states of light using the running keys R to produce a multi-bit information bearing light signal (see Dultz column 2 line 46 – column 4 line 10 i.e. polarization of light into two optical bases, 0 and 1) with at least 10 photons on average (see Dultz column 2 line 46 – column 4 line 10 i.e. high-energy photon).

With respect to claim 23, producing the light signal includes projecting light from a source of light equally into first and second polarization modes of light (see Dultz column 2 line 46 – column 4 line 10 i.e. polarization of light into two optical bases, 0 and 1).

Dultz in view of Schneier teach everything with respect to claim 23 above but with respect to claim 24, they do not teach modulating the two-mode coherent states of light includes introducing a relative phase shift between the first and second polarization modes of light. Townsend teaches modulating the two-mode coherent states of light includes introducing a relative phase shift between the first and second polarization

modes of light (see Townsend column 3 line 1 – column 4 line 8). It would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains to have introduced different phase shift from 0 – 2Π to stand for whether a 0 or 1 was obtained.. Therefore one would have been motivated to have introduced a phase shift to stand for a 0 or one.

With respect to claim 25, the relative phase shift introduced between the first and second polarization modes of light is in the range of 0-2π radians (see above Townsend column 3 line 1 – column 4 line 8).

With respect to claim 27, the signal components of the light signal are macroscopically distinguishable (see Dultz column 2 line 46 – column 4 line 10 i.e. two optical bases, 0 and 1).

With respect to claim 28, the extended key K' includes 2^s-l bits, where s is the number of bits of the seed key K (see Schneier figure 12.1 and page 270-278 i.e. K_1, $K_2 \ldots K_n$).

With respect to claim 29, the number of bits r of each block is equal to $\log_2(M)$ and s >> r, where M is the number of bases formed by the first and second polarization states of light and s is the number of bits of the seed key K (see Schneier figure 12.1 and page 270-278 i.e. K_1, $K_2 \ldots K_n$).

With respect to claim 30, Dultz in view of Schneier teach a method for transmitting data between first and second locations, said method comprising the steps of: encrypting data to be transmitted by producing at the first location a plurality of polarization-mode coherent states of light with at least 10 photons on average (see

Dultz column 2 line 46 – column 4 line 10 i.e. high-energy photon) (see Dultz column 2 line 46 – column 4 line 10 i.e. polarization of light into two optical bases, 0 and 1); extending a multi-bit seed key K to produce a multi-bit extended key K', the length of which is greater than the length of the seed key K (see Schneier page 270-278); segmenting the extended key K' into a plurality of disjointed blocks of running keys R, each of the running keys being r-bits in length; and modulating a finite number of the polarization-mode coherent states of light with at least 10 photons on average (see Dultz column 2 line 46 – column 4 line 10 i.e. high-energy photon) using the running keys to produce a multi-bit information bearing light signal (see above Schneier figure 12.1 and page 270-278 i.e. K_1, $K_2 \ldots K_n$); transmitting the information bearing light signal over a communication channel from the first location to the second location (see Dultz column 2 line 46 – column 4 line 10); and decrypting the transmitted data at the second location including extending the same multi-bit seed key K at the second location to produce the extended key K', the length of which is substantially greater than the length of the seed key K (see above Schneier page 270-278); segmenting the extended key K' into a plurality of disjointed blocks of running keys R, each of the running keys being r-bits in length (see above Schneier figure 12.1 and page 270-278 i.e. K_1, $K_2 \ldots K_n$); applying unitary transformations to the received polarization states according to the extended key K' (See Dultz figure 3b and column 2 line 46 – column 4 line 10). They do not teach wherein the relative phase shift introduced is determined by the extended key K' generated and applied to the information bearing light signal; and processing the received information bearing light signal to cancel polarization rotation caused by

communication channel, whereby after the phase shift has been applied, the relative phase shift between the first and second polarization modes is 0 or π radians corresponding to logic 1 and logic 0 bits, respectively, according to the extended key K'. Townsend teach wherein the relative phase shift introduced is determined by the extended key K' generated and applied to the information bearing light signal (see Townsend column 3 line 1 – column 6 line 40); and processing the received information bearing light signal to cancel polarization rotation caused by communication channel, whereby after the phase shift has been applied (see Townsend column 5 line 57 – column 6 line 40), the relative phase shift between the first and second polarization modes is 0 or π radians corresponding to logic 1 and logic 0 bits, respectively, according to the extended key K' (see above Townsend column 3 line 1 – column 4 line 8). It would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains to have a polarization compensator in the receiver is then adjusted via a feedback loop in order to linearize the output polarization and match it to the preferred polarization axis of the receiver. Therefore one would have been motivated to have used a polarization compensator in the receiver.

With respect to claim 33, each bit of the information bearing light signal is defined by a number of photons in the range of 1,000 to 100,000 photons (see Townsend column 5 line 31 – column 6 line 40 i.e. multi-photon pulse).

With respect to claim 34, Dultz in view of Schneier teach everything with respect to claim 30 above but do not teach amplifying the information bearing light signal as

prior to processing the information bearing light signal at the second location. Townsend teaches amplifying the information bearing light signal as prior to processing the information bearing light signal at the second location (see Townsend column 3 line 1 – column 5 line 9). It would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains to have included an amplifier to use a small amount of energy to control a larger amount of energy. Therefore one would have been motivated to have used an amplifier.

With respect to claim 35, extending the seed key includes using the seed key K to drive an encryption mechanism to produce the extended key K' (see Schneier page 270-278)

With respect to claim 36, a method for transmitting data, said method comprising the steps of: encrypting at a first location data to be transmitted by producing a light signal that includes two-mode coherent states of light with at least 10 photons on average (see Dultz column 2 line 46 – column 4 line 10 i.e. high-energy photon); extending a multi-bit seed key K to produce a multi-bit extended key K', the length of which is substantially greater than the length of the seed key K; segmenting the extended key K' into a plurality of disjointed blocks of running keys R, each of the running keys being r-bits in length; and modulating a finite number of the two- mode states of light using the running keys produce a multi-bit information bearing light signal with at least 10 photons on average (see Dultz column 2 line 46 – column 4 line 10 i.e. high-energy photon); transmitting the information bearing light signal, including the modulated polarization states of light from the first location to a second location through

a communication channel; and the transmitted data at the second location including extending the same seed multi-bit K to produce the extended key K', the length of which is greater than the length of the seed key K; applying unitary transformations to the received polarization states according to the extended key by using a modulator to introduce relative phase shift determined by the extended key K' generated and applied to the information bearing light signal (see above Townsend column 3 line 1 – column 4 line 8); and processing the information bearing light signal to cancel the polarization rotation caused by the communication channel, whereby after the phase shift has been applied, the relative phase shift between the polarization modes is 0 or π corresponding to logic 1 or logic 0 according to the extended key (see above Townsend column 3 line 1 – column 4 line 8).

With respect to claim 37, the communication channel is a guided media (see Dultz column 3 lines 11-17 i.e. fiber link).

With respect to claim 38, producing the light signal includes projecting light from a source of light equally into two polarization modes of light (see Dultz column 2 line 46 – column 4 line 10 i.e. polarization of light as a function of time).

With respect to claim 39, modulating the two-modes states of light at the first location includes introducing a relative phase shift between the two polarization modes of light (see above Townsend column 3 line 1 – column 4 line 8).

With respect to claim 40, the relative phase shift introduced between the two polarization modes of light is in the range of 0-2π radians (see above Townsend column 3 line 1 – column 4 line 8).

With respect to claim 42, including amplifying the information bearing light signal while the information bearing light signal is being transmitted from the first location to the second location (see above Townsend column 3 line 1 – column 4 line 8).

With respect to claim 43, a seed key K drives an encryption mechanism the output of which is to be used for each qumode carrying bit b (0, I) (see Dultz column 2 line 46 – column 4 line 10 i.e. polarization of light into two optical bases, 0 and 1).

With respect to claim 44, including using a seed key extended to a longer key to modulate the parameters of a multi-mode coherent states of light (see Dultz column 2 line 46 – column 4 line 10 i.e. polarization of light into two optical bases, 0 and 1).

With respect to claim 45, including using an encryption mechanism to extend the short seed key K (see Schneier page 270-278).

With respect to claim 46, processing the light signal includes future rotating the received polarization states of light by an amount equal to π/4 (see above Townsend column 3 line 1 – column 4 line 8).

With respect to claim 47, signals of each pair of light signals are macroscopically distinguishable (see Dultz column 2 line 46 – column 4 line 10 i.e. two optical bases, 0 and 1).

With respect to claim 48, a communication system comprising: means for generating a large number of quantum signal sets of low to high energy (see Dultz column 2 line 46 – column 4 line 10 i.e. high-energy photon of the laser breaks down into two low-energy-energy); and means for modulating the sets of quantum signal with the data being encrypted by using a multi-bit seed key to select quantum signal sets for

different bit values, whereby each quantum signal set is encoded into a coherent state with at least 10 photons on average (see Dultz column 2 line 46 – column 4 line 10 i.e. high-energy photon) of an infinite-dimensional space (see Dultz column 2 line 46 – column 4 line 10 i.e. polarization of light into two optical bases, 0 and 1).

With respect to claim 49, means for extending the multi-bit seed key K into a much longer extended key K' (see Schneier page 270-278) that is used to determine for each qumode carrying bit b (0, 1), which quantum signal set is to be used.

With respect to claim 50, the extended key K' includes 2^s-1 bits, where s is the number of bits of the seed key K (see Schneier page 270-278).

Allowable Subject Matter

Claim 10, 18, 26, 31, 32, and 41 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within

TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Devin Almeida whose telephone number is 571-270-1018. The examiner can normally be reached on Monday-Thursday from 7:30 A.M. to 5:00 P.M. The examiner can also be reached on alternate Fridays from 7:30 A.M. to 4:00 P.M.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Gilberto Barron, can be reached on 571-272-3799. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Devin Almeida
Patent Examiner
8/13/2007

DA

GILBERTO BARRON JR
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2100